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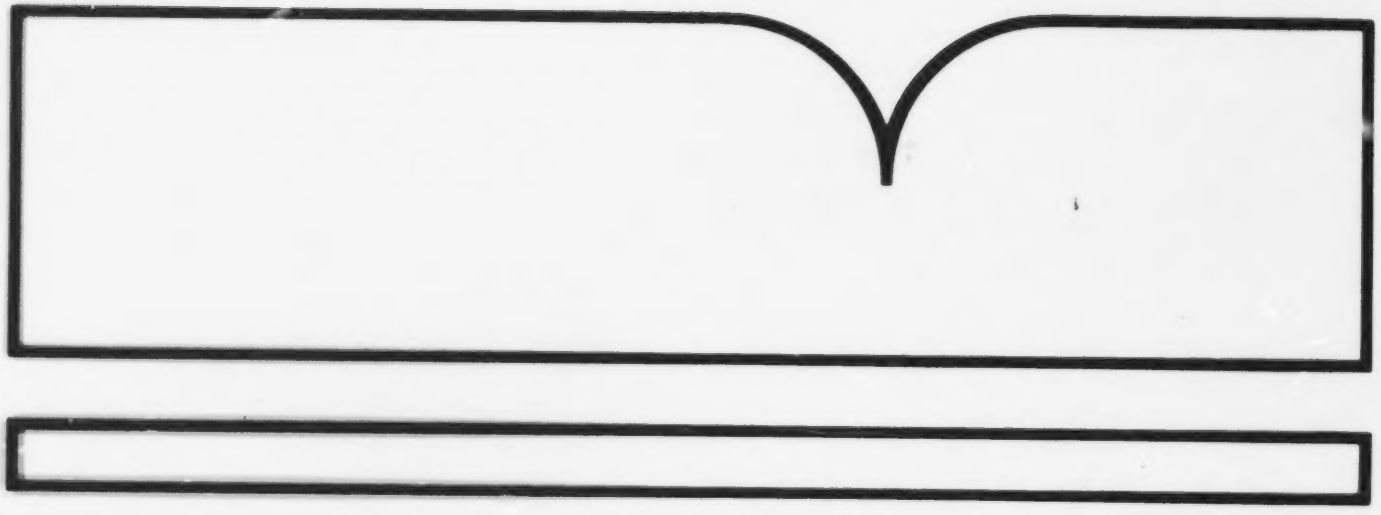
Urban Air Toxics Monitoring Program

Engineering-Science, Inc., Cary, NC

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

Sep 87



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EPA

URBAN AIR TOXICS MONITORING PROGRAM

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16. ABSTRACT To assist States and local agencies, EPA has developed a program to address the status of the air toxics problem in their localities. This document provides a description of (1) the program, (2) support EPA will provide to participating agencies and (3) the responsibilities of State and local agencies.		
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URBAN AIR TOXICS MONITORING PROGRAM

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U.S. ENVIRONMENTAL PROTECTION AGENCY
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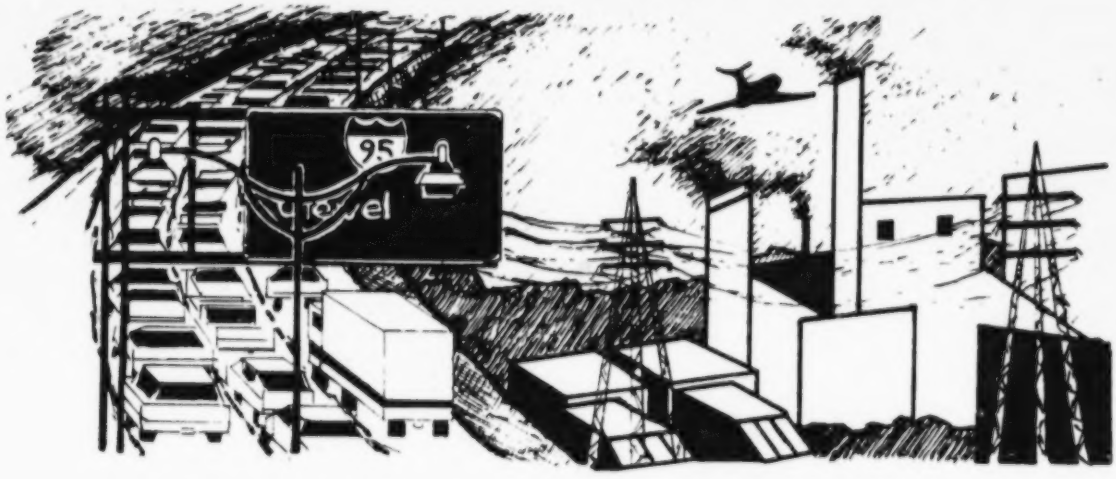
EPA-450/4-87-022

URBAN AIR TOXICS MONITORING PROGRAM



BACKGROUND

The Urban Air Toxics Monitoring Program was developed by EPA as a way for state and local agencies to address the status of the air toxics problem in their localities, and EPA strongly encourages agencies to participate in the program. Following is a brief description of the fundamentals of the air toxics program.

- What is the program? A national ambient screening study sponsored by EPA to assist state and local agencies to assess the nature and magnitude of their air toxics problems, primarily in urban areas.

- Why participate in the program? The monitoring program is in response to the finding of potential increased health risks associated with certain air toxic pollutants. Data generated from the study can be used to determine the presence and levels of high risk substances and the need for additional assessment.

- Where will the program take place? The program is primarily intended to support data collection in major urban areas throughout the United States. However, any area may participate if it wants to address a particular area of concern.

- Who will take part in the program? The program is primarily designed for participation by state and local air pollution control agencies which are being encouraged by EPA to assess the nature and magnitude of the air toxics problem.

- When will the program begin/end? The program began in late September, 1987 and will continue a minimum of one year after the starting date. Depending on future funding allocation and interest shown by state and local agencies, follow-on programs may be initiated for the next 2-3 years.

URBAN AIR TOXICS PROGRAM DESCRIPTION

Recent studies have indicated a potential of elevated individual lifetime cancer risks associated with certain air toxics often found in urban areas. High risk urban areas result from complex pollutant mixtures rather than from specific point sources which for the most part have been identified and controlled. In response to results of these studies, the Office of Air Quality Planning and Standards (OAQPS) is initiating a screening study entitled Urban Air Toxics Monitoring Program. The primary purpose of the Urban Air Toxics Monitoring Program is to support state and local agency efforts to assess the nature and magnitude of the urban air toxics problem in their respective areas.

EPA's objectives in promoting and supporting this program are:

- o to provide estimates of annual concentrations of selected air toxics,
- o to provide information for prioritizing and planning future work and sampling on a more in-depth and pollutant specific basis in local areas,
- o to provide a means to identify prevailing pollutants and possible source types which may need further assessment, and
- o to identify a means to evaluate and prioritize future air toxics mitigation programs.

The program calls for state and local agency personnel to collect ambient air samples for subsequent analysis either by EPA or an EPA contractor for specific toxic compounds (Table 1).

Three different types of ambient air samples are to be collected. The first set of air toxics samples will be collected in stainless steel canisters for 24-hour periods every 12 days for one year. After sample collection, the canisters are air shipped to a central laboratory for analysis. The samples are analyzed for selected volatile organic compounds (VOCs) by gas chromatography equipped with multi-detector capability. The second set of samples will be collected in cartridges for determination of aldehydes. The third set will be total suspended particulates (TSP) collected from a high-volume air sampler for determination of selected metals and benzo(a)pyrene [B(a)P].

In FY87, States participated in this program at a very reasonable cost of $20K per site.* Nineteen state and local agencies (Table 2) have already agreed to participate in this program.

* Cost in FY88 and beyond may vary.

TABLE 1

URBAN AIR TOXICS MONITORING PROGRAM
COMPOUNDS TARGETED FOR ANALYSIS

Canister Sampling	CAS No.	Add-on Cartridge	CAS No.	High-Volume Filter	CAS No.
Vinyl chloride[a]	75-01-4	Formaldehyde	50-00-0	Arsenic[b]	7440-38-2
1,3-Butadiene[a]	51-03-6	Acetaldehyde	75-07-0	Barium[d]	7440-39-3
Benzene	71-43-2	Acrolein	107-02-8	Beryllium[d]	7440-41-7
Methylene chloride	75-09-2	Other Aldehydes		Cadmium[d]	7440-43-9
Carbon tetrachloride	56-23-5			Cobalt[b]	7440-48-4
Ethlyene dichloride	107-06-2			Copper[d]	7440-50-8
Methyl chloride[a]	74-87-3			Chromium[b]	7440-47-3
Trichloroethylene	79-01-6			Iron[d]	7439-89-6
Chloroform	67-66-3			Manganese[d]	7439-96-5
Perchloroethylene	127-18-4			Molybdenum[d]	7439-98-7
Chloroprene	126-99-8			Nickel[d]	7440-02-0
1,4-Dichlorobenzene	106-46-7			Lead[d]	7439-92-1
Acetylene[a]	74-86-2			Vanadium[d]	7440-62-2
Toluene	108-88-3			Zinc[d]	7440-66-6
Xylene	1330-20-7			B(a)pc	50-32-8
n-Octane	111-65-9				
1,3-Dichlorobenzene	54-17-3				
1,2-Dichlorobenzene	95-50-1				
1,1,1-Trichloroethane	71-55-6				
Propylene[a]	115-07-1				
1,1,2-Trichloroethane	79-00-5				
1,1,2,2-Tetrachloroethane	79-34-5				
Styrene[a]	100-42-5				
Bromomethane	74-83-9				
Chlorobenzene	108-90-7				
1,1-Dichloroethane	75-34-3				
1,2-Dichloropropane	78-87-5				
Dibromochloromethane	124-48-1				
Bromodichloromethane	75-27-4				
Chloroethane	75-00-3				
trans-1,2-Dichloroethylene	540-59-0				
Bromochloromethane	74-97-5				
trans-1,3-Dichloropropene	542-75-6				
cis-1,3-Dichloropropene	542-75-6				
Bromoform	75-25-2				

[a] Potential of compounds coeluting on the proposed analytical column; therefore, qualitative and quantitative identification may be limited.
[b] Determined by neutron activation analysis (NAA).
[c] Determined by thin layer chromatography (TLC).
[d] Determined by inductively coupled plasma (ICP) optical emission spectroscopy.

TABLE 2

PRESENTLY COMMITTED SAMPLING SITES
FOR THE 1987 URBAN AIR
TOXICS MONITORING PROGRAM

U.S. EPA REGION	SITE	URBAN AIR TOXICS MONITORING PROGRAM EMPLOYING 24-HOUR EVACUATED CANISTER TECHNIQUE
I	Burlington, VT	1
IV	Atlanta, GA	1
	Birmingham, AL	1
	Louisville, KY	1
	Jacksonville, FL	1
	Miami, FL	1
V	Chicago, IL	1
	Cleveland, OH	1
	Detroit, MI	1
	Dearborn, MI	1
	E. St. Louis (Sauget, IL)	1
	Hammond, IN	1
	Port Huron, MI	1
	Midland, MI	1
	East Lansing, MI	1
VI	Dallas, TX	1
	Houston, TX	1
	Baton Rouge, LA	1
X	Portland, OR	1

SUPPORT TO PARTICIPATING AGENCIES

EPA and its central contractor will provide support to participating state and local agencies through the following activities:

- o provide all sampling equipment, including incidental supplies such as canisters, aldehyde cartridges and high-volume sample filters. The state or local agency is responsible for furnishing and setting up a high-volume sampler for each site selected,
- o set up all necessary equipment, except high-volume sampler, for sample collection,
- o train personnel on program operation and management (equipment operation, sample collection, and sample shipment),
- o provide sample analysis for the preselected pollutants,
- o provide data results, and
- o provide standard operating procedures (SOP) including Quality Assurance/ Quality Control (QA/QC) procedures for data collection and analysis.

Under EPA direction, the central contractor will bring the necessary sampling train to each site, assemble the apparatus, instruct the sampling technician on equipment operation and maintenance, and provide detailed sample shipping information. Participating personnel will schedule a meeting date and location for the contractor to set up and demonstrate the sampling trains. Use of a central contractor for technical support for all participating agencies is expected to provide:

- o good communications among participating States, EPA, and the contractor,
- o consistency of sampling practices,
- o consistency of overall program operations, and
- o increased accuracy through standardization of analytical procedures in a central laboratory.

State and Local Responsibilities

All air toxics samples will be collected by participating agency personnel. Participating agencies will be responsible for:

(1) selecting personnel and delegating responsibilities to collect samples,
(2) selecting sampling sites,
(3) maintaining sampling stations,
(4) collecting samples,
(5) shipping samples to laboratory for analysis,
(6) providing high-volume sampler, and
(7) receiving and reviewing data results.

(1) Selecting Personnel and Delegating Responsibilities - Within the framework of the existing agency operation, personnel should be selected and delegated responsibilities for site selection, equipment and site maintenance, sample handling, and data interpretation. Selected personnel will be responsible for interaction with central contractor personnel to ensure program objectives are met.

(2) Selecting Sampling Sites - To better characterize the air toxics situation in their localities, participants are encouraged to select more than one sampling site for each urban area. Two or more study sites would provide a more definitive evaluation of the presence and magnitude of air toxics in the areas of interest.

Monitoring site selection criteria depend upon the objectives of the ambient monitoring program. If the agency is using the data as a secondary tool to roughly assess what pollutants are present in the urban area, it is recommended that the monitoring site should:

- represent as nearly as possible the typical ambient air quality to which the population is exposed, and
- not be unduly dominated by a single source (mobile or stationary).

If an existing monitoring site meets these criteria, colocation of the existing site with the urban air toxics monitoring site is recommended.

For a more detailed discussion of criteria for monitoring site selection, refer to Network Design and Site Exposure Criteria For Selected Non-criteria Air Pollutants, EPA-450/4-84-022, September, 1984.

(3) Maintaining Sampling Stations - The central contractor will bring air toxics sampling trains to each of the sites and instruct the sampling operator on how to run them.

The toxics sampling train includes a heated manifold, valves, pumps, flow controllers, timers, and associated hardware, packaged in a medium size case. The central contractor will provide instruction on initial site preparation, sampler installation, operation/maintenance of sampling system, and shipment of air toxics sample containers. A more detailed explanation of the sampling train and analytical methods is contained in the Appendix accompanying this document.

The air toxics sampling train should be housed in a room that is air-conditioned during the summer and heated during the winter to maintain a constant room temperature of approximately 25°C. The high-volume sampler should be located close by (perhaps on the roof of the same building). The exhaust of the high-volume sampler should be properly vented or located so the exhaust will not interfere with the inlet of the air toxics sampling train.

(4) Collecting Samples - During sampling, agency personnel will collect 24-hour integrated ambient air toxics samples in 6-liter SUMMA®-polished stainless steel canisters at participating sites. Evacuated canisters will be filled nearly to atmospheric pressure using a mass flow controller to maintain a constant flow rate for 24 hours.

Formaldehyde samples will be collected on dinitrophenylhydrazine (DNPH)-coated cartridges at 1 L/min for 24 hours, using a critical orifice and a vacuum pump. The canisters and the formaldehyde cartridges will be filled from a common heated stainless steel manifold. Duplicate samples will also be collected periodically.

TSP samples will be collected in the high-volume sampler simultaneously with the canister and cartridge samples at each monitoring site.

(5) Shipping Samples - Filled sample canisters, high-volume sampler filters, and formaldehyde cartridges will be identified and shipped to the specified laboratory for analysis. Fresh empty canisters, filters, and cartridges will be delivered to the participating agency prior to each day that samples are scheduled to be taken. The central contractor will furnish shipping instructions to site operators when the site is activated. All samples should be shipped as soon as possible after collection.

(6) Providing High-Volume Air Sampler - The participating agency will be required to provide a flow controlled high-volume sampler as part of the Urban Air Toxics Monitoring Program. A flow controller is used with this high-volume sampler so the air sample flow rate can be accurately controlled.

(7) Receiving and Reviewing Data Results - Upon receipt of the air toxics samples, the central laboratory will analyze the samples for formaldehyde, other aldehydes, ketones and selected organics (Table 1) within a few days. Results of these analyses will be reported quarterly and provided to the participating agency. Results for the high-volume samples [B(a)P and metals] will require more time due to the QA/QC validation program required by the National Particulate Network (NPN) program. Results for B(a)P and metals will be made available to the participating agencies approximately six months after sample receipt.

NMOC/OPTIONAL AIR TOXICS PROGRAM

Many States are currently participating in the Non-methane Organic Compound (NMOC) program. The current NMOC program is a continuation of the NMOC Monitoring Network Program which focused on collection of total NMOC data for ozone State Implementation Plan (SIP) development. EPA has managed the current NMOC program for the past four summers (1984-87). The purpose of the NMOC program is to collect total and speciated NMOC and nitrogen oxides (NO_x) data needed for ozone SIP modeling analyses.

In conducting the NMOC program, participating state and local agency personnel collect samples in canisters and air freight them to Research Triangle Park for analysis by a central contractor. Agencies are provided with all necessary sampling equipment which they colocate with a NO_x monitor. NMOC canister samples are collected from 6-9:00 a.m. every weekday for four months (June-September). FY87 costs for participating agencies are $19K per site.* Participants of the ambient NMOC and optional air toxics programs are listed in Table 3.

* Cost in FY88 and beyond may vary.

TABLE 3

CURRENT PARTICIPANTS IN THE AMBIENT 3-HOUR NMOC/OPTIONAL AIR TOXICS MONITORING PROGRAMS

U.S. EPA REGION	SITE	TOTAL NMOC ANALYSIS	OPTIONAL AIR TOXICS
I	Boston, MA	2	2
	Hartford, CT	1	
II	New York, NY	2	2
	Newark, NJ	1	1
IV	Atlanta, GA	2	2
	Birmingham, AL	1	1
	Louisville, KY	1	1
V	Chicago, IL	2	2
	Cincinnati, OH	1	1
VI	Dallas, TX	1	
	Ft. Worth, TX	1	
	Houston, TX	1	
	El Paso, TX	1	
	Beaumont, TX	1	
	Longview, TX	1	
	Baton Rouge, LA	1	
VII	St. Louis, MO	1	
VIII	Salt Lake City, UT	2	
IX	San Francisco, CA	2	
	San Diego, CA	2	
	Fresno, CA	2	
	Bakersville, CA	1	
	Pittsburgh, CA	1	
X	Portland, OR	1	

The NMOC program is conducted in the same manner as the Urban Air Toxics Monitoring Program. NMOC participants have the same responsibilities as those taking part in the Urban Air Toxics Monitoring Program. Criteria for delegating program responsibilities, selecting sampling sites, sampling train operation/maintenance, sample shipment and data review are common to participants of both programs.

Total NMOC concentrations are determined by the Preconcentration and Direct Flame Ionization Detection (PDFID) method. Some of the samples are further speciated by the GC/FID method for QA/QC evaluation associated with the NMOC monitoring program. In a supplementary limited effort to characterize air toxics, some samples are also analyzed for toxics species by a GC multi-detector procedure. This additional analytical program will cost an additional $2K.

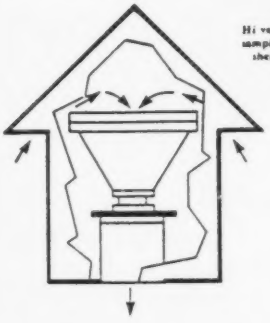
Limitations of the ambient NMOC/optional air toxics programs are:

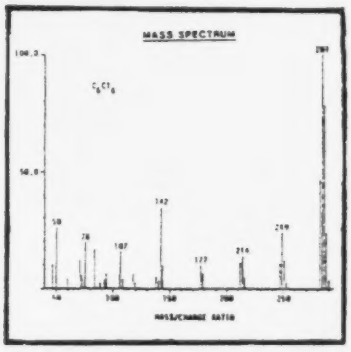
- o sampling is done only during the summer,
- o only 3-hour samples are collected, and
- o relatively few ambient air samples are analyzed for speciated air toxics.

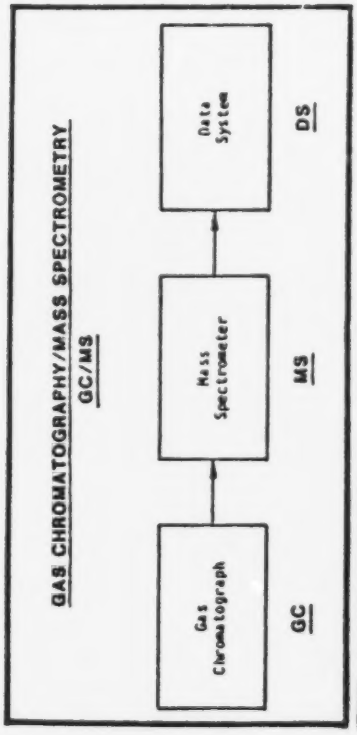
Recognizing these limitations, EPA encourages participation in the more comprehensive Urban Air Toxics Monitoring Program, the results of which should provide a more adequate data base on which to structure a state or local agency air toxics program.

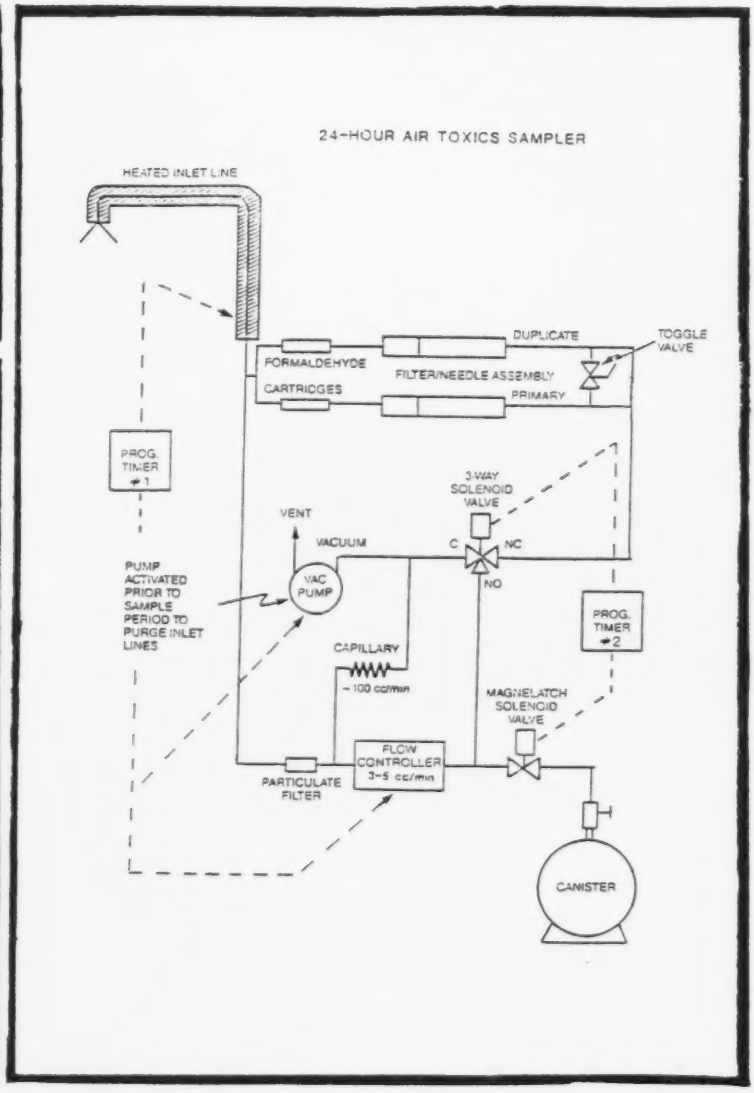
APPENDIX

Sampling Techniques
Equipment
Sample Analysis









SAMPLING TECHNIQUES/EQUIPMENT

Urban air toxics samples are collected in 6-liter SUMMA® polished canisters. Formaldehyde samples are collected in DNPH-coated cartridges. Canister sampling for VOCs is an alternative to VOC collection on solid sorbents (e.g., Tenax). Many VOCs which cannot be collected on Tenax (due to high volatility, polarity, or reactivity) can be efficiently collected and stored in canisters. Also, the canister contents may be analyzed repeatedly. The central contractor will prepare and deliver all sampling equipment (except high-volume sampler) to agency personnel.

Coated adsorbent cartridges are used as direct probes and traps for sampling aldehydes in ambient air. Aldehyde sample collection is based on the reaction of aldehydes with the acidified, DNPH-coated cartridges to form a stable derivative which is then analyzed to determine the concentration of the aldehydes.

SAMPLING TECHNIQUES

Evacuated Canister Sampling

The evacuated canister method requires no pump. Since the canister is at a pressure lower than atmospheric, the air sample flows through the heated manifold and mass flow controller and into the canister. The electronic flow controller regulates and maintains a constant flow of approximately 3 cc/min to the canister. Prior to sample collection, a vacuum pump is activated by a timer to flush the heated manifold and particulate filter assembly with sample air. After a predetermined flushing period, a second timer opens the magnelatch solenoid valve to allow sample gas to enter the evacuated canister. Figure A-1 shows a schematic of the sampling system equipped with evacuated canisters and DNPH-coated cartridges. After sample collection, the canisters are returned to a central laboratory for analysis of the ambient air samples. Collection of ambient air samples in canisters provides a number of advantages, including:

- o convenient integration of ambient samples over a specific period,
- o ability to ship and store samples,
- o remote sampling capability, with subsequent central laboratory analysis,
- o unattended sample collection,
- o analysis of samples from multiple sites with one analytical system, and
- o collection of duplicate samples for assessment of sampling precision.

DNPH-Coated Cartridge Sampling

In the DNPH-coated cartridge sampling method, ambient air is drawn through the heated manifold and into the cartridge by a vacuum pump. Ambient

air is drawn through the cartridges for 24 hours at a constant flow rate of 1 L/min. Periodically, duplicate samples are collected. This sampling system is illustrated in Figure A-1.

After sampling, the DNPH-coated cartridges are capped at each end and placed in a glass culture tube to minimize contamination. The culture tubes are then shipped back to the central laboratory for analysis.

Filter Sampling

In the filter sampling method, ambient air is sampled by a high-volume air sampler. TSPs are collected on the filter at a continuous air flow rate of 1130-1700 L/min (40-60 ft^3/min). After sample collection, the glass fiber filter is placed in a clean, sealed container, shipped to the central laboratory, and analyzed for metals and B(a)P.

SAMPLING EQUIPMENT

Ambient air is drawn into a sampling train which comprises an evacuated canister(s) and DNPH-coated cartridge(s), and other components which include an electronic flow controller that regulates the rate and duration of sampling. The canisters are treated internally by the "SUMMA" polishing process in which a pure chrome/nickel oxide is formed on the interior surface. This type of canister has been used in the past for sample collection and a number of studies have been performed to demonstrate analyte stability in the canisters.

The inlet system consists of a stainless steel filter to remove aerosols, and a stainless steel inlet line leading to a flow controller, pump, canister(s) and cartridge(s). During operation, the flow controller maintains a constant flow rate to the evacuated canister(s). Sample air flows into the initially evacuated canisters(s) and through the DNPH-coated cartridges for a 24-hour period.

For automatic operation, a programmable timer starts and stops the air toxics sampler at the appropriate times for the intended sample period.

Prior to field use, the central contractor will test each sampling system for pump contamination, leaks, and proper operation, and clean and check the canisters for contamination.

SAMPLE ANALYSIS

The central contractor will arrange for analysis of the samples collected and shipped to the specified laboratory by agency personnel. The analytical laboratory will follow procedures prescribed by EPA for determination of preselected air toxics compounds. Organic toxic compounds will be analyzed using gas chromatography, aldehydes will be analyzed using high performance liquid chromatography (HPLC), metals will be analyzed using neutron activation analysis (NAA) and inductively coupled plasma (ICP) spectroscopy and B(a)P will be analyzed by thin-layer chromatography. Table 4 outlines the sampling schedule and analytical procedures for each of the programs discussed. Following is a brief description of the analytical techniques for each program.

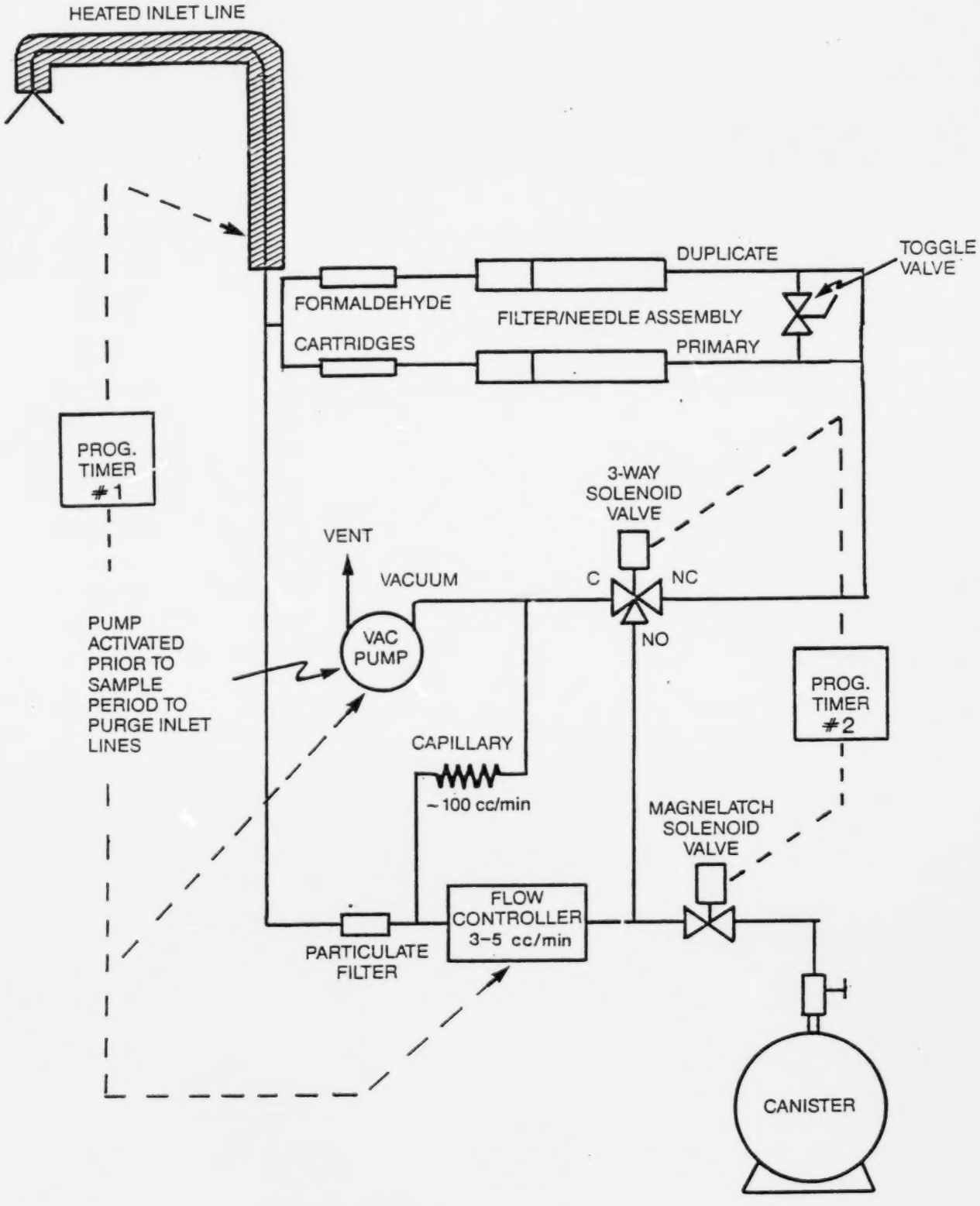


FIGURE A-1. SAMPLING ASSEMBLY FOR 24-HOUR URBAN AIR TOXIC MONITORING PROGRAM

TABLE 4

SAMPLING SCHEDULE/ANALYTICAL PROCEDURES FOR THE NMOC/AIR TOXICS MONITORING PROGRAMS

Program	Pollutant	Sampling Schedule			Sampling Configuration	Analytical Procedures			Comments
		Period	Date	Length		Trapping	GC Column	Detector[1]	
Urban Air Toxics Monitoring Program	Air Toxics Species	24 hours	Every 12th day	Year	Evacuated SUMMA®-Polished Canisters	Cryogenic (liquid argon)	Fused Silica	PID/ECD/FID	
NMOC Monitoring Program	Total NMOC	6:00-9:00 A.M.	Each week-day	June - Sept.	Pressurized SUMMA®-Polished Canisters	Cryogenic (liquid argon)	None	FID	Continuation of the NMOC Monitoring Network Program. Sample Analyzed by PDFID.
Optional Air Toxics Monitoring Program	10% of Total NMOC Canisters Are Analyzed For Air Toxic Species	6:00-9:00 A.M.	Each week-day	June - Sept.	Pressurized SUMMA®-Polished Canisters	Cryogenic (liquid argon)	Fused Silica	PID/ECD/FID	

1
PID - Photoionization Detector
ECD - Electron Capture Detector
FID - Flame Ionization Detector

3-HOUR TOTAL NMOC ANALYSIS

The 3-hour NMOC canister samples are analyzed by the PDFID method. This method involves sample preconcentration in a glass-beaded trap cryogenically cooled to approximately -186°C with liquid argon. The cryogenically-cooled trap simultaneously concentrates the NMOC while passing methane, nitrogen, oxygen, etc. through the trap. The system is dynamically calibrated so that the volume of sample passing through the trap does not have to be measured, but must be precisely repeatable between the calibration and the analytical phases.

After the fixed-volume air sample has been drawn through the trap, the trap is heated and a helium carrier gas flow is diverted to pass through the trap and into a flame ionization detector. The organic compounds previously collected in the trap volatilize and are carried into the FID, resulting in a response peak(s). The area of the peak(s) is integrated and the value is translated to concentration units by a previously obtained calibration curve relating integrated peak areas with known concentrations of a standard.

Concentrations of NMOC are reported in units of parts per million carbon (ppmC), which for a specific compound is the concentration by volume (ppmv) multiplied by the number of carbon atoms in the compound.

In addition to PDFID for all 3-hour NMOC samples, a minimum of 10% of the canister samples will be speciated by a GC/FID equipped with a fused silica capillary column. This serves as a QA/QC check of the ambient NMOC monitoring program.

3-HOUR TOXICS ANALYSIS

The 3-hour air toxics samples are analyzed by a gas chromatograph equipped with photoionization, electron capture and flame ionization detectors. For separation and subsequent identification by the selective detectors, the GC multi-detector technique relies on the analytes' retention times and selective detector peak response ratios for specific compounds.

The analytical system consists of a cryogenic trap, a GC column and selective detectors. In the cryogenic trap, the air toxics are concentrated prior to GC separation. The trap is then heated and the previously collected organic compounds volatilize and are carried to the GC column by the carrier gas. The GC column is temperature programmed for subambient cooling to provide improved resolution for the compounds of interest. After the column separates the organics, the effluent gas stream containing the separated organics enters a series of detectors consisting of electron capture, photoinization and flame ionization. The individual detectors respond to the sample components as a succession of peaks above a baseline on the chromatogram.

The area under the peak approximately quantifies the component, while the time lapse between injection and emergence of the peak serves as a preliminary identification. Detector peak response ratios are also used to perform peak identification. Further confirmation and identification will be performed on 20% of the total samples by gas chromatography/mass spectroscopy (GC/MS). Concentrations of toxic species are reported in units of ppb by volume (ppbv).

24-HOUR URBAN AIR TOXICS ANALYSIS

TOXICS ANALYSIS

The 24-hour Urban Air Toxics Monitoring Program canisters are analyzed with similar equipment previously described under the 3-hour air toxics analysis. In summary, the organics (Table 1) in the canister are concentrated in a cryogenic trap, revolatilized, separated on a fused silica capillary column and monitored by PID, ECD, and FID electronic detectors. The combination of the three detectors enables detection of different classes of organics which normally could not be evaluated by a single detector. The air toxics in the canister are qualitatively and quantitatively characterized through the GC multi-detector procedure and confirmed by GC/MS.

ALDEHYDE ANALYSIS

Aldehydes are extracted from the DNPH-coated cartridges by gravity feed elution of acetonitrile from a plastic syringe reservoir to a graduated test tube or a volumetric flask. The eluate is then topped to a known volume. The DNPH-formaldehyde derivative is determined by reverse phase HPLC with an ultraviolet (UV) absorption detector. Formaldehyde and other carbonyl compounds in the sample are identified and quantified by comparison of their retention times and area counts with those of standard samples.

METAL ANALYSIS

Metals collected by the high-volume sampler are analyzed by inductively coupled plasma(ICP) spectroscopy and neutron activation analysis. The detection limit and sensitivity of the analytical methods determine which technique will be employed for specific metal analysis (Table 1). The ICP analytical technique uses a plasma gas to ionize sample components at temperatures up to 10,000 K. In the ICP analysis, the sample is heated and cooled to produce spectral lines representative of the sample components. The spectral lines resolved in the spectrometer and the relative intensities of selected lines of the elements are fed into a small computer. The computer calculates concentrations based upon emission intensity of spectral lines. This technique allows simultaneous analysis of up to 50 elements per sample, thus reducing cost and analytical time. Table 1 outlines those metals analyzed by ICP.

Neutron activation analysis provides an accurate and sensitive means of determining a large number of elements in a wide variety of samples. It is a multi-element analytical technique based on selectively inducing radioactivity in the sample's elements and measuring the radiation emitted by the radioactive atoms. This procedure allows for qualitative identification and quantitative determination of the elements from which the radiations are measured. The radioactivation is accomplished by bombarding the element's atoms with thermal neutrons. The energies and intensities of the radiation are measured with a high-resolution detector coupled with an analyzer system. Table 1 outlines the metals historically analyzed by neutron activation analysis.

B(A)P ANALYSIS

B(a)P and other polycyclic organic matter (POM) are captured on the high-volume filter by drawing air through the filter at a rate of 1130-1700 L/min (40-60 ft^3/min). At the end of the sampling period, the filter is retrieved and returned to a central laboratory for analysis.

During analysis, a portion of the filter (1-in. by 8-in. strip) is immersed in cyclohexane and sonicated to extract the residual B(a)P. A sample of this solution is spotted on a thin-layer plate and developed in an ethanol/methylene chloride matrix to separate the dissolved B(a)P from other POM's. The B(a)P is then quantified by ultraviolet fluorescence spectrometry. The analytical range of the method is 0.4 to 8.0 ng/80 uL, which corresponds to 0.18 to 3.6 ng/m^3, assuming an air volume of 2000 m^3.

DETECTION LIMITS

The analyses of the collected samples will identify those chemical species (Table 1) which are present in concentrations which equal or exceed the sensitivity of the proposed test methods. For those compounds identified, an approximation of their concentrations will be obtained. Historically, detection limits for GC/FID, GC/ECD, and GC/PID are 200 pg, 0.1 pg, and 1 pg, respectively. In general, the normal sampling/analysis detection limits associated with each method are estimated as:

Technique	Pollutant	Approximate Detection Limit
Evacuated Canister	Organics	1.0 ng/m^3
DNPH-Coated Cartridges	Aldehydes	18.0 ng/m^3
High-Volume Sampler	Metals	4.0 ng/m^3
High-Volume Sampler	B(a)P	0.18 ng/m^3